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Engine Performance Analysis with Respect to the Change in the Compression Ratio of Single Cylinder Four Stroke Diesel Engine

Dhruv Patel[1], Rajkumar Patel[2], Alpesh Barot[3], Krupesh Patel[4]

[1,2,3,4] Government Engineering College, PATAN (384265), Gujarat, India

Abstract: ***Improving Internal Combustion (IC) engine efficiency is a prime concern today. A lot of engineering research has gone into the improvement of the thermal efficiency of the (IC) engines, to get more work from the same amount of fuel burnt. Most of the energy produced by these engines is wasted as heat. In addition to friction losses and losses to the exhaust, other operating performance parameters affect the thermal efficiency. The concept of change in compression ratio promises improved engine performance, efficiency and reduced emissions. In the present research study, the effect of different compression ratios on diesel engine studied and optimum compression ratio was determined. The compression ratios set for study were ranging from 14 to 18 for diesel engine. The present study focuses on investigating the better compression ratio for the diesel engine at variable loads by changing the gasket thickness.***

Keywords: Diesel engine, compression ratio, gasket, analysis

1. Introduction

Engine performance is measured at different compression ratio with the use of brake dynamometer. The four-stroke diesel engine test rig has Four-stroke single cylinder water-cooled diesel engine by Gujarat forgings, Brake dynamometer apparatus and Fuel measurement apparatus. In laboratory change in compression ratio is achieved by changing the thickness of engine head gasket

2. Apparatus with specification

Single cylinder water cooled diesel engine**.**

- Made by: Gujarat forging Pvt. Ltd. GF 1B
- Output power at shaft: 5 H P/3.7 KW, 1500 r p.m.
- Stroke: 110 mm.
- bore: 80 mm
- original compression ratio): 16.5:1
- engine bare weight: 149 kg

Dynamometer

- Type: Mechanical (Belt Drum) type
- Diameter of drum = 170 mm
- Thickness of belt = 6 mm

Tachometer

- Type: electrical (RPM)type

Fuel measurement tank

- Mounted on a sturdy iron stand, burette tub and
- Three valve connections.
  capacity: 9 litre

Stopwatch
Temperature measurement sensors

3. Experiment Procedure

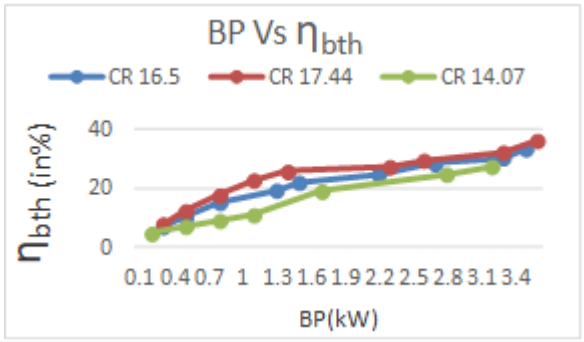
In theoretical cycle, we assume that there is no friction loss or exhaust gas loss, cooling water heat loss or there is no variation of sp. heat of gases with temperature. Therefore, the efficiency of the cycle is independent of these. But in actual cycle on which the engine works must depend on these factors and due to these losses the efficiency of the engine is less than that of theoretical cycle. Engines are required to be tested mainly for on a production line of engines and in research purposes the basic measurements which usually should be undertaken to evaluate the performance of an engine are

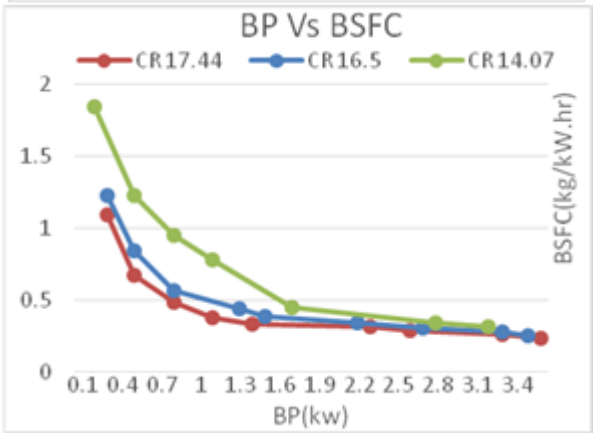
- I.P., F.P. and B.P.
- Fuel consumption.
- Torque and load.
- Brake thermal efficiency.
- Mechanical efficiency.

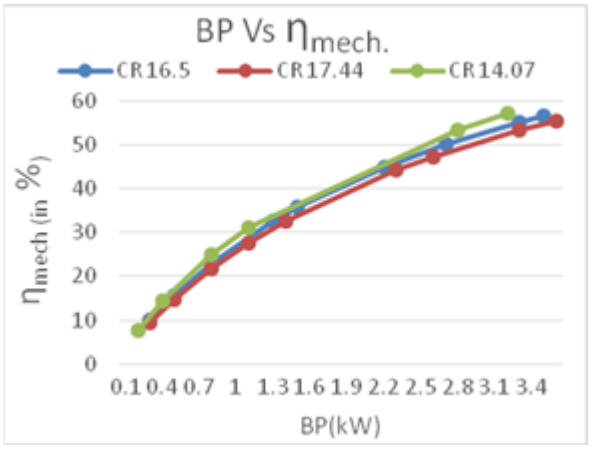
Procedure

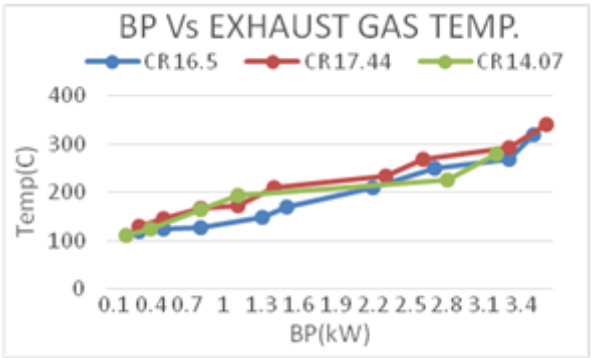
1) Check the level of the diesel in tank and lime up with the fuel pump through fuel measuring apparatus.
2) Start the engine by hand cranking with no load condition.
3) As the engine pick up speed, start water to the brake drum.
4) Put a light Load in the engine with loading screw.
5) Achieving steady state condition, note down all the necessary data (fuel consumption, cooling water flow rate, brake drum speed with tachometer, different temperatures.
6) After noting down repeat the steps 4 and 5 for different load.
7) Before stop the Engine remove the load and run the engine on no-load for two minutes.
8) Stop the engine.
9) Turn off cooling water supply to engine after one minute.

4. Graphs









of the compression ratios, the fuel consumption is high due to incomplete combustion of the fuel.

Reduction in the thickness of the gasket helps in increasing the compression ratio but thin gasket may increase chances of leakage and may fail at long usage 'In this kind of setup where cooling water flow rate can be controlled the compression ratio 17.44 is found to be more useful but higher compression ratio leads to high engine temp and high NOx and CO_X emissions. So control over the temp is very necessary too high cooling rate as well as too low cooling rate may lead to improper combustion of the fuel.

The impact of compression ratios on the combustion and performance parameters was clearly investigated in this study over the entire loading conditions at various CR and the following observations were noted.

Reduction in BSFC (Brake specific fuel consumption) of about 5.86% was observed when CR (compression ratio) was increased from 16.5 to 17.44 and BTE (Brake thermal efficiency) improved by 2.81 % at full load on increasing the CR.

The exhaust gas temperature showed a slight increment when CR was increased from 16.5 to 17.44 Increment in BSFC of about 10.83% was observed when CR was reduced from 16.5 to 14.07 and BTE reduced by 5.96% at full load on decreasing the CR.

The exhaust gas temperature showed a slight reduction when CR was decreased from 16.5 to 14.07 Compression ratio of 17.44 is considered to be the useful CR with better BTE and BSFC compared to both CR. (cooling water flow rate 70 ml / sec)

References

[1] Unit 7 IC engine testing – IGNOU
[2] Gujarat forging private limited

5. Conclusion

The general conclusions drawn from the results of this work for Diesel Engine are as follows as the compression ratio of the engine is increased, BSFC decreases. At the lower sides